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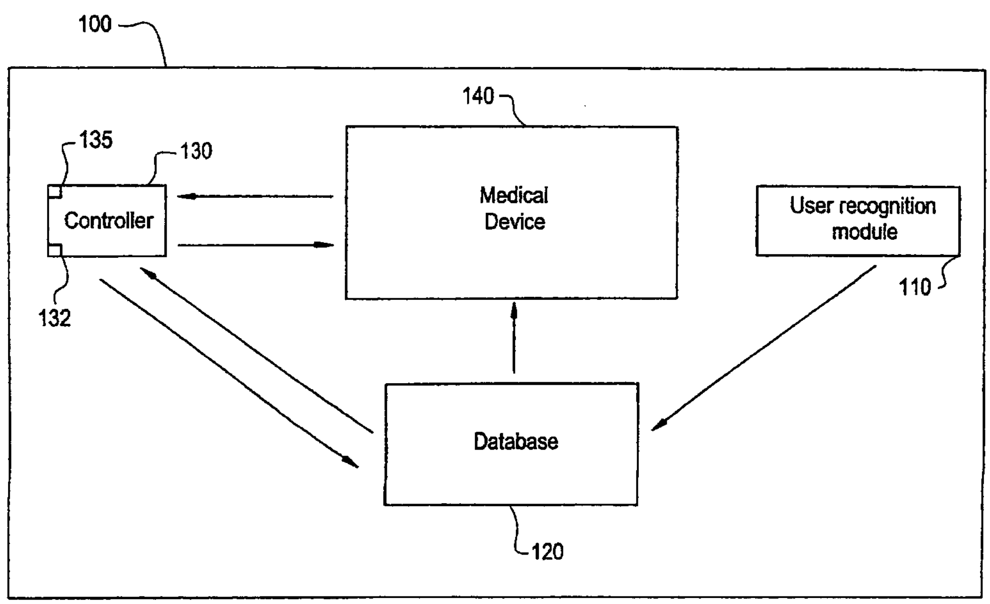
(54) Title: AUTOMATING USER CUSTOMIZATION OF A MEDICAL DEVICE



(57) Abstract: An automated system (100) for configuring a medical device (140) to comply with the user's preset preferences. After recognizing the user, a controller (130) obtains the user's default preference settings from a database (120) and then adjusts the machine settings to comply with the user's preset defaults. A computer (132) monitors the user inputs to determine whether the user changes any of the default settings, making record of each instance in which the user overrides the default. If the system (100) determines that the user is overriding the default setting, the computer (132) will then update the user's default setting based on the characteristics of the setting being adjusted, as well as the setting's variable type.

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AUTOMATING USER CUSTOMIZATION OF A MEDICAL DEVICE

BACKGROUND OF THE INVENTION

The present invention generally relates to adjusting the settings on a medical device. More particularly, the present invention relates to an automated system that configures the medical device based on the user's preset preferences.

Medical devices such as X-ray systems or monitoring systems have several user selectable adjustments. These adjustments include table height, spatial or temporal filtering, screen layouts, and the like. Since it is common for such machines to be used in a hospital, where numerous doctors have access to and use the machine, each doctor must manually configure these settings to the doctor's own preferences before each use.

Conventional automated systems simply adjust the machine settings based on the doctor's default preferences. Conventional automated systems contain databases that store the doctor's preferences. Many types of prior art systems would not update the doctor's preferences unless the doctor went through the time consuming task of entering the database and manually changing the setting. Oftentimes the system required a technician to manually adjust the setting on the machine. Thus, prior art systems did not allow for easy updating of the default system settings if a doctor's preference changed over time.

In other conventional systems the default setting reset after every use. Once the system recognized the user, the system adjusted the system settings to the value last used by the doctor. However, these prior art systems did not take into account the need for a doctor to adjust the system in accordance with a particular patient's needs. Some machine settings are based on traits such as the patient's weight, height or build. Doctors often have to adjust a machine in order to meet the needs of each individual patient. Since it is unlikely that two consecutive patients will have exactly the same traits, the doctor will still have to manually adjust the settings to meet the needs of the next patient. Conventional systems do not take into account the reason why the doctor changed the system setting, nor consider the extent of the variation in the system settings.

Thus, there has been a long felt need in the medical field for an automated system that configures a medical device, monitors a doctor's use and updates the default system settings in accordance with consistent changes made by the doctor. The preferred embodiments of the present invention address these needs and other concerns.

BRIEF SUMMARY OF THE INVENTION

The preferred embodiments of the present invention provide an automated system and method of use therefore that configures a medical device to a doctor's preferences without having to manually adjust the settings before each use. The system utilizes a user recognition module to identify a particular user. Once the system recognizes the user, the system automatically accesses a database containing the preset default preferences for that individual user. The preset default preferences are then downloaded to a controller that adjusts the medical device settings in accordance with these defaults.

The automated system also updates the preset default preferences to comply with the doctor's current preferences. The controller includes a computer that monitors each time the doctor uses a particular function and makes a record of each

instance in which the doctor changes a default setting. When such a change occurs, the computer first determines whether the doctor is overriding a preset default setting. Doctors are often faced with situations in which they must adapt a system to meet a patient's particular needs, such as when doctors are dealing with an unusually heavy patient or a very young, small patient. In such a situation, the doctor must adjust the medical device's settings to effectively treat or diagnose the patient. However, it is unlikely that the doctor will want this single change to affect his or her preset default settings. The system receives patient information, such as the patient's weight, which allows it to recognize when the doctor is treating a patient with unusual characteristics. If the system determines that the patient has unusual characteristics, the system will not consider any changes to the settings as an override, and therefore, not adjust the preset default settings.

However, if the system determines that the doctor is not treating a patient with irregular needs, the system will identify the change as an override of the default settings and update the preset default settings accordingly. In updating the default settings, the system identifies which parameters are being adjusted. The system supports at least two types of settings, namely 1) those that depend on the doctor's preferences and 2) those that depend on the characteristics of a particular patient. Parameters that relate primarily to a doctor's particular preferences include items such as table height (which corresponds to the height of the doctor) or table side control configuration (which is determined by whether the doctor is right-handed or left-handed) (hereinafter user-specific traits). Since the traits rarely change, the default setting parameters associated solely or primarily with user-specific traits will remain fairly constant. Thus, if a doctor overrides one of the user-specific traits, it is likely that the override reflects a change in the doctor's preference, and therefore, the system will reset the default settings to comply with the new setting.

However, a slightly more complex process arises when a parameter depends on the patient's characteristics, such as the patient's height, weight or build. Unlike the doctor's preferences, device parameters associated with patient characteristics may be adjusted frequently. A change in one patient dependant parameter usually reflects a doctor's attempt to adapt the device to the needs of a

particular patient rather that the doctor's own preferences. Thus, rather than resetting the user's preset default preferences, the system calculates a new default parameter setting using pre-programmed algorithms. The pre-programmed algorithms limit the effect of a single override based on the characteristics of the parameter, such as whether the parameter is a continuous or discrete variable.

Continuous variables, such as spatial blurring or sharpening, may be set at one of many different values within a given range. If the doctor overrides a continuous variable, the system will use a filtered algorithm to update the variable, such as an algorithm that compares the average value for a specified number of uses (i.e. the average setting over the last 10 patients) and updates the default setting for the variable only if the variation between the average and the default setting is statistically significant. In this manner, the system monitors long-term trends in preferences without allowing short-term changes made by the doctor to skew the default settings.

Discrete variables, on the other hand, may only be set to a limited number of values, such as a switch that may either be turned on or off. Since the values for discrete variables are limited, it is nearly impossible to calculate an average default value (a switch cannot be 65% on). Thus, to prevent single changes from greatly altering the default setting, the system updates the default settings only if a particular value for a discrete variable is used a preset number of times, such as 3 out of the last 4. Thus, regardless of the parameter characteristics or the variable type, the system adjusts the setting default value to accurately reflect the doctor's current preferences.

These and other features of the present invention are discussed in the following detailed description of the preferred embodiments of the present invention. It shall be understood that other features and advantages will become apparent to those skilled in the art upon review of the following detailed description, drawings, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates an apparatus for automating user-customization of a medical device in accordance with a preferred embodiment of the present invention.

Figure 2 illustrates a flowchart outlining the steps carried out by the system in accordance with a preferred embodiment of the present invention in order to set the parameters and variables of the medical device.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 illustrates a schematic block diagram of an automated system in accordance with a preferred embodiment of the present invention for updating the parameter settings of a medical device. The system 100 includes a user recognition module 110, a database 120 and a controller 130 for monitoring, calculating and controlling the parameter settings for a medical device 140. The system 100 is compatible with any medical device that contains adjustable parameters, such as X-ray, ultrasound, MRI, CT, nuclear medicine, medical imaging equipment and the like.

At step 200, the user (usually a doctor) wishing to use the medical device simply identifies himself or herself to the system via the user recognition module 110. The user recognition module 110 may implement several different methods that are well known in the art to identify the user, including through a key or tag worn by the doctor, voice recognition, retinal pattern recognition or use of a user login or password. The type of user recognition performed by the module 110 depends on the system technology available and the normal system operation. Since doctors often wear identification badges, one preferred embodiment may implement an identification mechanism within the user's badge.

Once the user recognition module 110 recognizes the user, the system 100 accesses the database 120 that stores a plurality of user default preferences for one or more parameters of the corresponding medical device (step 202). By way of example, the database 120 may store one or more user default preferences for each doctor that uses a particular medical device 140. Each user default preference may comprise values for a set of parameters, such as table height, table side control

configuration, spatial blurring, image contrast and sharpness parameters and the like. The user default preferences for a particular user may include a set of values discrete and/or continuous parameters, representing a set of default settings.

The doctor may either enter the data prior to the first use, or the settings entered during the first use may automatically become the default settings. Also, the format of the database may vary. For example, the database 120 may be quite simple, with the user ID as the database key or index and the parameters listed as fields under that index. Alternatively, the database 120 may be organized with a standard ".ini" format, or (name, value) format. Furthermore, the database can be divided into several subdivisions per user. In this manner, doctors may enter separate user default preferences for a single machine, such as differing user default preferences when a doctor is X-raying a hand as opposed to a chest. The stored user default preferences are then downloaded to the controller 130 which in turn automatically adjusts the settings for the parameters of the medical device 140 in accordance with a selected set of user default preferences.

An alternate embodiment may include a database 120 that is remotely located from the medical device 140. In order to download the settings, the medical device 140 communicates with the database 120, such as via the internet, an intranet, local area network, wide area network or the like. Doctors who practice at multiple hospitals or offices may easily access user default preferences regardless of his or her location. Furthermore, the default settings can be entered and/or changed immediately without requiring a doctor or third party to be present at the medical device 140.

Also, the use of a database 120 at a remote location may allow a single database 120 to store particular user's default preferences that are common to numerous medical devices. Many medical devices have common settings such as table height and table side control configuration. In this embodiment the database 120 is in communication with numerous machines, and thus, the system 100 may update these common settings in accordance with the user's most recent parameter settings regardless of what medical device is being used.

Once the medical device 140 is configured, the doctor may begin to use it. The controller 130 includes a computer 132 that monitors use of the medical device 140 in order to adjust and update the doctor's user default preferences in accordance with the doctor's most recent parameter entries (step 204). During monitoring, the computer 132 recognizes each adjustment by the doctor to parameter values or settings for the medical device 140 (step 206). Once the computer 132 recognizes a change, the computer 132 determines if the user is "overriding" the user default preferences (step 208). The computer 132 may use any of several different ways to identify overrides, including a simple preference capture routine that defines an override as any occasion in which the user adjusts any parameter. For example, a simple preference capture routine may direct the computer 132 to update the user default preferences each time that the user changes a parameter.

Alternatively, the computer 132 may utilize a more complex preference capture routine that analyzes and recognizes multiple reasons why the doctor may be adjusting the parameter setting. The "smart" preference capture routine prevents the computer 132 from updating the preferences too often. Once the computer 132 recognizes that the user is changing the parameter setting, the computer 132 decides whether to adjust the user default preference in accordance with the user's action based upon the parameter setting that the doctor is adjusting and based upon the environment and patient characteristics. Since the preferred embodiment of the present invention may be used with various medical devices with adjustable parameter settings, each specific parameter is not listed herein. However, in several medical devices, the parameters may be classified into one of two categories by the system 100, namely parameters that depend on the doctor's personal preferences and parameters that depend on the particular patient's characteristics.

Certain parameter settings relate directly to the doctor's likes or dislikes. Settings such as table height or table side control configuration depend on the doctor's height and on whether the doctor is left handed or right handed. Since these traits typically do not change from examination to examination, if a doctor changes one of these settings the computer 132 assumes that the doctor is overriding

his or her default. Accordingly, processing passes to step 210, at which the computer 132 updates the user default preferences in the database 120.

On the other hand, settings such as spatial or temporal filtering strength depend more specifically on the patient's traits, such as the patient's build or weight. A doctor may have to adjust the amount of filtering performed by the medical device 140 to adapt to a specific situation (such as an unusually heavy patient, or a very young, small patient). It is unlikely that the next patient will be of the same relative height, weight and build. Thus, the doctor typically will not need the medical device 140 to return to the settings needed for the previous patient, especially if the previous patient had unusual characteristics. In other words, if the doctor is treating a patient having one or more unusual characteristics, the computer 132 should not consider any change made by the doctor to any parameter setting as an override at step 208. Hence, processing passes to step 212.

The computer 132 is provided with patient characteristic information at or before step 208. Based on the patient characteristic information, the computer 132 determines if a parameter change constitutes an override. The computer 132 may obtain the patient characteristic information in several manners. For example, the computer 132 may access patient characteristic information from either a hospital or remote database. Since it is common practice for a doctor to receive information such as weight before treating a patient, this information may be easily obtained. If it was not hospital policy to obtain patient characteristic information prior to treatment, the medical device 140 may also include one or more sensors in order to obtain the patient characteristic information, such as weight. If the computer 132 determined that the patient's weight did not fall within a preset range, the computer would not update the user default preferences based on the changes made during the particular treatment.

Alternatively, the controller 130 may provide the doctor with an override switch 135. The switch 135 controls the inputs to the medical device 140 and may specifically control one or more parameter settings. If the doctor desired to adjust a parameter setting but did not want that single change to affect his or her user

default preferences, the doctor could simply engage the override switch, notifying the computer 132 not to update the user default preferences based on the present change.

Optionally, the computer 132 may monitor the time at which a particular parameter adjustment took place. In most situations, a doctor adjusts the medical device 140 to his or her liking prior to using the medical device. Thus, the computer 132 may assume that any adjustment made after an examination has commenced is based on the patient's needs rather that a change to the doctor's preferences, and thus will not be considered to override the user default preferences.

When the computer 132 determines that the doctor is overriding a parameter setting, the computer 132 updates the user default preferences accordingly (step 210). Numerous database update routines are well-known, and thus, the preferred embodiments are not limited to any particular methods of recalculating or updating the user default preferences. In the preferred embodiment, the computer 132 identifies whether a particular parameter is a continuous or discrete variable. Continuous variables may be set at one of many different values. Examples include table height or spatial filtering, that may be set at any value within a given range. Since these variables may be adjusted to several different values, a filtered algorithm may be used to determine consistent patterns in a doctor's use. The following are examples of such algorithms.

According to a simple algorithm, the computer 132 continuously filters the user selections, such as a simple alpha filter:

$$\text{Default}_{\text{NEW}} = \alpha*\text{Default}_{\text{OLD}} + (1-\alpha)*\text{User\_Selection}$$

where $\text{Default}_{\text{NEW}}$ is the new default setting, $\text{Default}_{\text{OLD}}$ is the previous default setting, User_Selection is the user's input value and $0 \# \alpha < 1$. In the above equation, alpha (α) may equal zero (in which case the computer would reset the default setting after every use), or any value up to one (in which case the computer

would never update the default setting). The higher the value of alpha, the less effect the new value will have on the setting for the particular user default preference.

In using the above equation, each parameter may be assigned its own alpha value by the doctor depending on how drastic a change the user desires after every use. For example, parameters that depend primarily on the doctor's preferences would have a very low alpha value, even zero. As mentioned above, parameters such as table height or table side configuration rarely change, if at all. Thus, a change by the doctor likely reflects a change in personal preference. For example, if a doctor changed the table side control configuration (say because the doctor developed arthritis in his dominant hand), the system 100 may assume that the doctor would like this same configuration in all future exams. Thus, if the computer 132 recognizes that the doctor is changing one of these parameters, the computer 132 should reset the user default preferences to comply with the doctor's new preference.

Alternatively, other parameters depend more on the patient's characteristics, and therefore, may change more frequently. In updating patient dependent parameters, the user will use a much higher value of alpha to prevent the computer 132 from updating the default settings after every use. If the user determines that the assigned alpha value results in either too much or too little deviation in a default setting, the user can readily change the alpha value for the given setting accordingly.

A slightly more complex alternative for updating continuous variable would monitor the typical magnitude of the variation of the overrides:

$$\text{NewAvg}_{\text{NEW}} = \alpha_1 * \text{NewAvg}_{\text{OLD}} + (1-\alpha_1) * \text{User\_Selection};$$

$$\text{Var'n}_{\text{NEW}} = \alpha_2 * \text{Var'n}_{\text{OLD}} + (1-\alpha_2) * (\text{User\_Selection} - \text{NewAvg});$$

$$\text{If } (\text{NewAvg} - \text{Default})/\text{Var'n} > 3.0, \text{ then Default} = \text{NewAvg}$$

where $\text{NewAvg}_{\text{NEW}}$ is the average including the present override value, $\text{NewAvg}_{\text{OLD}}$ is the previous average value (i.e. not including the present override value), User_Selection is the present override value, $\text{Var'n}_{\text{NEW}}$ and $\text{Var'n}_{\text{OLD}}$ are the

differences between the default and the new and old averages respectively, $0 < \alpha_1 < 1$ and $0 < \alpha_2 < 1$.

According to this alternative algorithm, the computer 132 updates the user default preferences only if the difference between the default and the current operating average is statistically significant (for example, designated in the above equation as 3.0). The user may adjust the level of "statistical significance" in order to allow the computer 132 to update the default more or less frequently.

Discrete variables, on the other hand, may only be set to a very limited number of values, such as a switch being on or off, on a setting for a right-handed or left-handed person. Since the number of values is limited, it is much easier to determine whether or not a doctor is overriding the value. However, it is much more difficult to determine whether that change is significant enough to warrant adjusting the default value. The computer 132 cannot simply calculate an average value for the setting. A simple algorithm could be used based on the number of times a particular value is used, such as 3 out of 5 times. A different numerical requirement could be used based on the number of settings available to the user. Again, although many other algorithms are well-known in the art, the exact algorithm used in updating these variables may vary, and thus additional algorithms will not be described herein.

It is apparent from the previous description that the present invention provides a novel system which satisfies the objectives and advantages set forth above. While particular elements, embodiments and applications of the present invention have been shown and described, it is understood that the invention is not limited thereto since modifications may be made by those skilled in the art, particularly in light of the foregoing teaching. It is therefore contemplated by the appended claims to cover such modifications and incorporate those features which come within the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. An automated system (100) for controlling parameter settings of a medical device (140) comprising:

a medical device (140) including adjustable settings;

a user recognition module (110) identifying a user;

a database (120) storing at least one parameter setting associated with a particular user's preferences for a configuration of said medical device (140);

a controller (130) for automatically adjusting said medical device (140) in accordance with a particular user's preference settings based on said at least one parameter setting; and

a computer (132) which recognizes each time the user overrides the user's preference settings and updates said at least one parameter setting based upon a value of a parameter override.

2. The automated system (100) of claim 1, further comprising an override switch (135) instructing said controller (130) whether to adjust said at least one parameter setting when the user changes a parameter setting.

3. The automated system (100) of claim 1 wherein said database (120) is remotely located from the medical device (140).

4. The automated system (100) of claim 3 wherein said database (120) communicates with the medical device (140) via the internet.

5. The automated system (100) of claim 3 wherein said database (120) stores a single user preference setting for settings that are common to multiple medical devices.

6. The automated system (100) of claim 1 wherein said the parameter settings are divided into multiple categories, at least one category of which

contains parameters associated with user-specific traits and another category of which contains parameters associated with patient-dependent characteristics, and said computer (132) recalculates said user's preference setting differently for each category.

7. The automated system (100) of claim 1 wherein setting parameters are either continuous or variable, and said computer (132) recalculates said user's preference setting differently for each type of parameter.

8. The automated system (100) of claim 7 wherein continuous parameters are updated using an alpha filter.

9. An automated system (100) for updating user preference settings of a medical device (140) in accordance with a user's preference setting comprising:

a user recognition module (110) identifying a user;

a database (120) storing at least one parameter setting associated with a particular user's preferences for a configuration of said medical device (140);

a controller (130) for automatically adjusting said medical device (140) in accordance with a particular user's preference settings based on said at least one parameter setting; and

a computer (132) which recognizes each time the user overrides the user's preference settings and updates said at least one parameter setting based upon a value of a parameter override.

10. The automated system (100) of claim 9, further comprising an override switch (135) instructing said controller (130) whether to adjust said at least one parameter setting when the user changes a parameter setting.

11. The automated system (100) of claim 9 wherein said database (120) is remotely located from the medical device (140).

12. The automated system (100) of claim 11 wherein said database (120) communicates with the medical device (140) via the internet.

13. The automated system (100) of claim 11 wherein said database (120) stores a single user preference setting for settings that are common to multiple medical devices.

14. The automated system (100) of claim 9 wherein said the parameter settings are divided into multiple categories, at least one category of which contains parameters associated with user-specific traits and another category of which contains parameters associated with patient-dependent characteristics, and said computer recalculates said user's preference setting differently for each category.

15. The automated system (100) of claim 9 wherein setting parameters are either continuous or variable, and said computer (135) recalculates said user's preference setting differently for each type of parameter.

16. The automated system (100) of claim 15 wherein continuous parameters are updated using an alpha filter.

17. A method for automatically controlling at least one parameter setting of a medical device (140) associated with an individual user preference for a medical device (140), comprising:

identifying a particular user;

obtaining at least one default parameter setting associated with preferences for the identified user;

adjusting the settings of the medical device (140) to conform to the user preferences;

monitoring a present state of parameter settings for the medical device (140);

recognizing when the parameter settings are changed for the said medical device (140);

determining whether a parameter change constitutes an override of a default parameter setting; and

when a change constitutes an override, updating said at least one parameter setting in accordance with the change.

18. The method of claim 17 wherein said the parameter settings are divided into multiple categories, at least one category of which contains parameters associated with user-specific traits and another category of which contains parameters associated with patient-dependent characteristics, and a computer (132) recalculates said user's preference setting differently for each category.

19. The method of claim 17 wherein setting parameters are either continuous or variable, and a computer (132) recalculates said user's preference setting differently for each type of parameter.

20. The method of claim 19 wherein continuous parameters are updated using an alpha filter.

FIG. 1

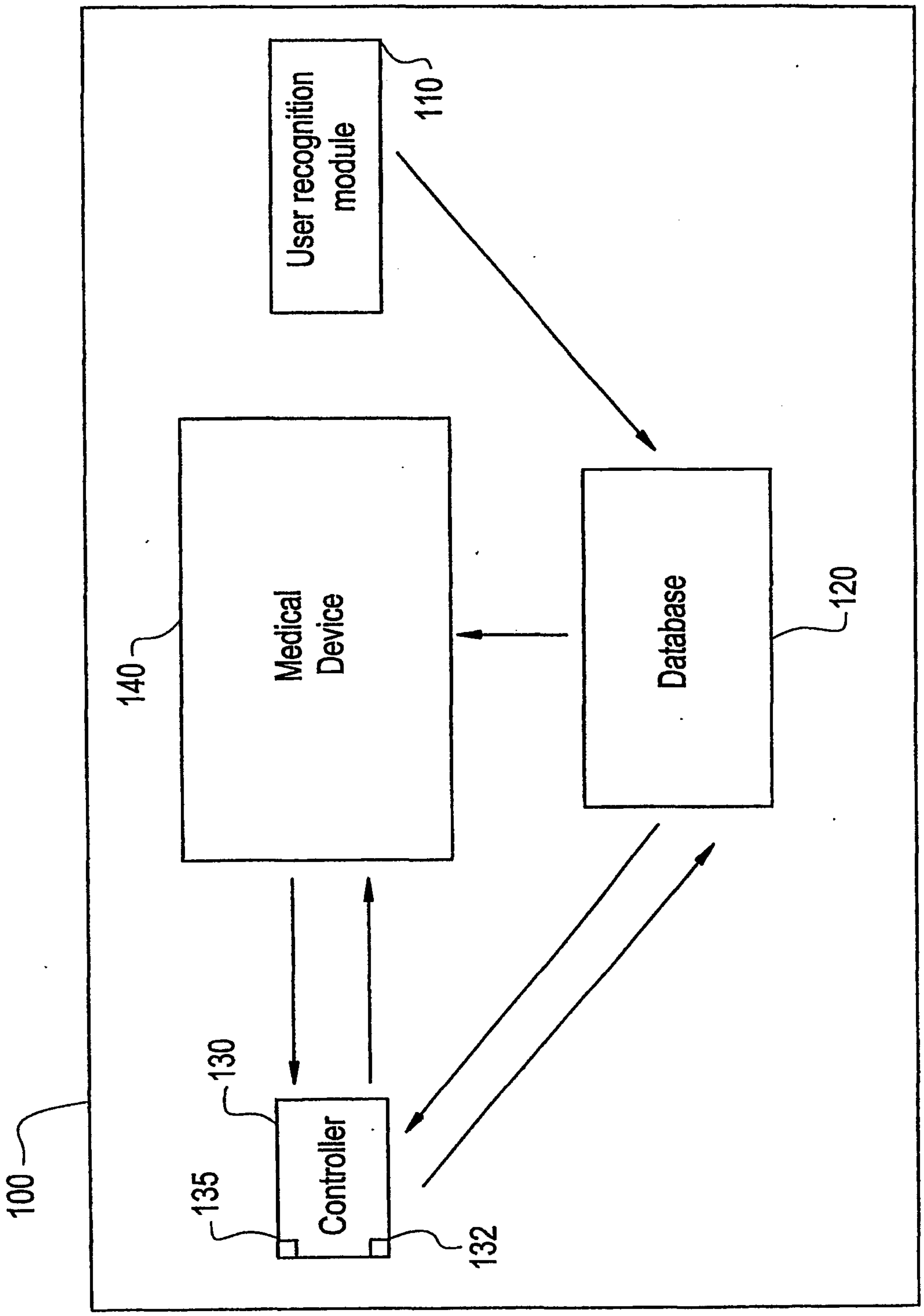
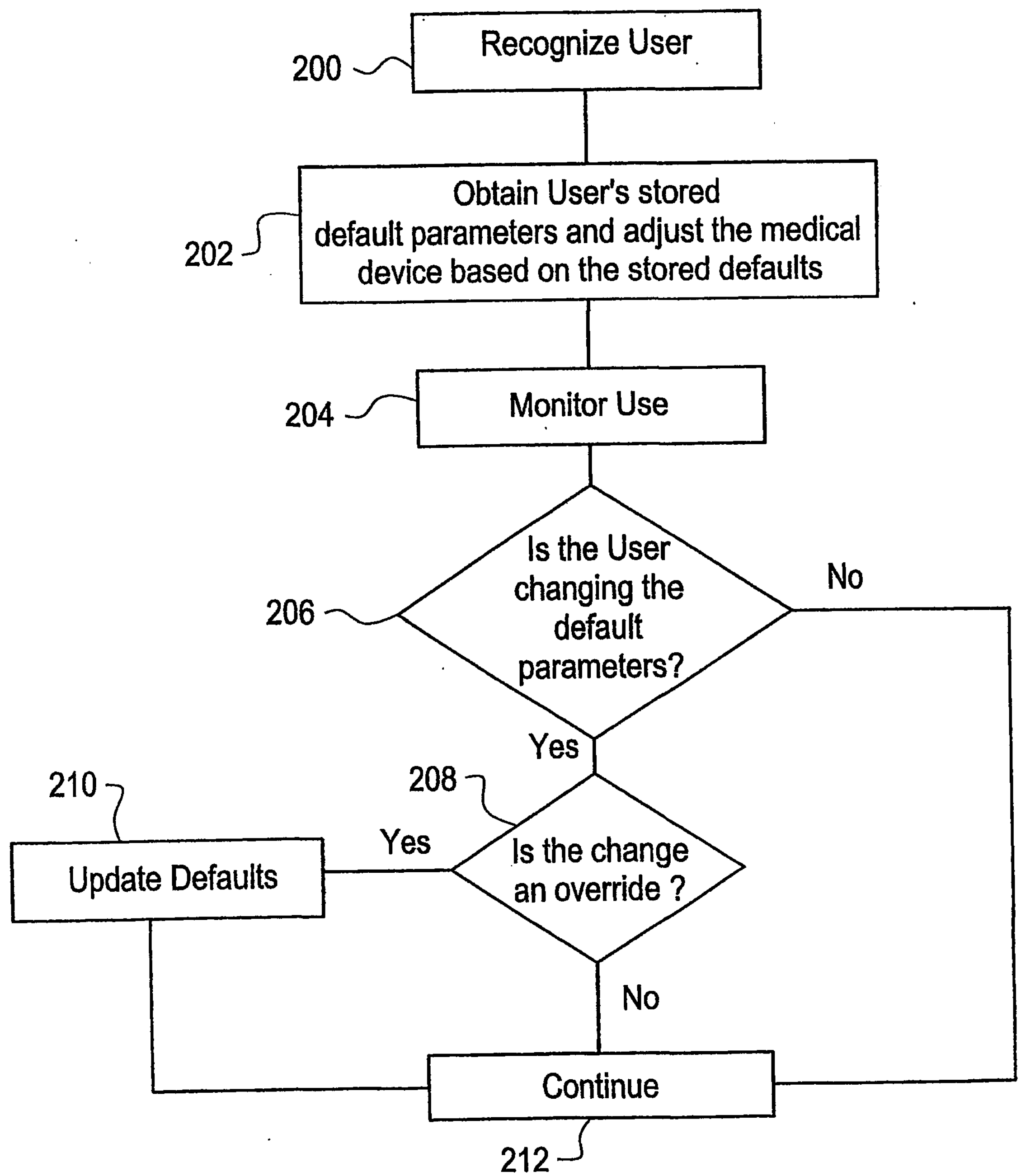

User recognition module
110
Medical Device
140
Database
120
Controller
130
135
132
100

FIG. 2


Recognize User
200
Obtain User's stored default parameters and adjust the medical device based on the stored defaults
202
Monitor Use
204
Is the User changing the default parameters?
206
No
Yes
208
Is the change an override ?
Yes
210
Update Defaults
No
Continue
212

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/09690

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B6/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 013, no. 149 (P-855), 12 April 1989 (1989-04-12) -& JP 63 310078 A (FUJITSU LTD), 19 December 1988 (1988-12-19)	1,2,7,9, 15,17,19
Y	page 2	3-5
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 131 (C-0700), 13 March 1990 (1990-03-13) -& JP 02 004350 A (FUJITSU LTD), 9 January 1990 (1990-01-09) page 2 page 4 figures 1-3	1,2,6,7, 9,10,14, 15,17-19

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[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 October 2001	10/10/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Martelli, L

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 14, 31 December 1998 (1998-12-31) -& JP 10 234730 A (SHIMADZU CORP), 8 September 1998 (1998-09-08) paragraph '0016! -----	3-5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/09690

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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